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GEOLOGICAL SURVEY OF CANADA
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ON

MICA.

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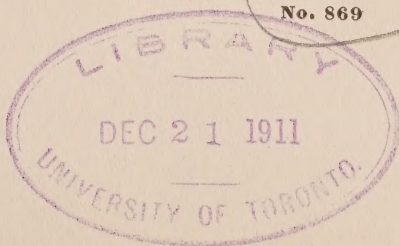
R. W. ELLS, LL.D., F.R.S.C.




OTTAWA

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MICA DEPOSITS OF CANADA

By R. W. ELLS.

The occurrence of mica in large and important deposits, at several points in eastern Canada, was recognized by the officers of the Geological Survey, almost from the commencement of the study of the crystalline rocks, and several references to this mineral are found in the earliest reports of the department. The true economic value of the mica deposits was not however ascertained until a comparatively recent date.

Its intimate association with apatite at many places was disclosed during the working of the latter deposits many years ago, but down to within the last fifteen years the mica was regarded practically of but small importance, and the quantity necessarily extracted in the removal of the apatite was thrown out on the dump. Around many of the old apatite mines, even at the present day, large quantities of this mineral, now rendered useless from long exposure to the weather, can be seen.

Generally speaking it may be said that mica came into marked prominence owing to the discovery of its fitness as an adjunct in the manufacture of dynamos and other electrical appliances, and as a consequence not only were many of the old mines, which were worked for apatite up to the decline of the market for that mineral some years ago, and in which mica was known to occur in considerable quantity, reopened, but its presence was soon ascertained in other portions of the crystalline rocks which had hitherto been unexplored. Many of the properties thus taken up as probably mica-bearing were soon abandoned, owing doubtless to the limited extent of the deposits in some cases, or to the inferior quality of the mica in others, but some of these have been developed into large and profitable mines which have been worked almost continuously for many years.

Chiefly used
for electrical
purposes.

Practically, at the present time, all the mica mining in Canada is confined to the provinces of Ontario and Quebec, with the exception of an area found in the Rocky mountains near Tête Jaune Cache, B.

C. The mica at this place occurs in a pegmatite dyke largely composed of quartz and feldspar, which cuts garnetiferous mica schist and gneiss, the mineral occurring in large clear crystals near the hanging wall. A description of this locality is given by Mr. James McEvoy in the Annual Report for 1898, Vol. XI, pp. 80-81, and is as follows:—

Mica in
British Co-
lumbia.

‘On one of these veins the Bonanza mica claim is located, seven miles south of Tête Jaune Cache, 5300 feet above the level of the Frazer river. The vein is about fifteen feet wide, where an opening has been made, dipping S. 45° W., conformably with the country rock. Its continuation toward the north-west is covered with talus from the mountain, while on the south-west side of the opening the original top of the deposit is seen covered by the mica-schist. At the time of our visit, Messrs S. Winter and J. F. Smith, with a party of ten men, were engaged in taking out and cutting mica intended for shipment by pack-horses to the nearest railway point. The quartz, feldspar and mica are separated into large masses, the crystals of mica being frequently eighteen inches long and eleven inches wide, and are found in greatest abundance near the hanging wall. It is evident that the mass was cooled at a great depth and very slowly to permit of this great amount of segregation. While practically no work has been done with a view of proving the extent of the deposit, it may reasonably be expected, from what actually appears, that a large quantity of mica can be obtained here. The mica is a transparent muscovite with a light greenish cast and is otherwise of excellent quality. The probabilities of further important developments appear to be favourable.

‘Another claim, owed by some Edmonton miners, is situated a few miles south-east of the Bonanza. Fifteen miles to the south-east on the mountains, near the head waters of the Canoe river, several claims have also been staked. On one of these some work has been done, exposing a deposit of marketable mica. It may be expected that further discoveries of valuable mica deposits will be made in these rocks, which are of the same character for a distance of twenty miles at least, and probably much further.

‘A great hindrance to the development of this or any other mining industry in this part of the country, is the difficulty of travelling without proper trails. It requires seventeen to twenty days to reach Tête Jaune Cache from Kamloops, a distance of 215 miles in the present state of the trail. From Edmonton to the Cache, a distance of about 350 miles, requires ordinarily twenty-five days, but in a very favourable season the distance might be covered in twenty days. It will thus be seen that, apart from the question of shipping out the

products of the mine, the greater part of the short season available is wasted in travelling to and fro. A moderate sum of money, if properly expended on these routes, would put them in a fairly passable condition.'

ONTARIO AND QUEBEC.

The mica bearing formation in eastern Canada belongs to that division of the crystalline rocks known generally as the Grenville and Hastings series, which to a great extent are now regarded as geological equivalents. They form part of what is usually styled the Laurentian system. While mica in small scales is an essential constituent of the granites and gneisses which form the great bulk of these rocks, the merchantable micas are always associated with intrusive masses and dykes of more recent date, which cut the gneiss and crystalline limestone at many points.

The mica-bearing dykes are usually of two kinds, viz., pegmatite-granite and pyroxene. The former consists largely of feldspar, both white and red, with quartz; the latter is probably an alteration from a hornblende diorite. In the light-coloured pegmatite the mica is generally a white muscovite, while the pyroxenes carry phlogopite or sometimes biotite, the latter being a blackish variety, having a large percentage of iron in its composition. As a rule it may be stated that the lighter coloured the matrix the lighter the tint of the contained mica, and when the dyke is composed of hard and dark material, the mica is usually a hard and brittle variety of little commercial value.

Mica-bearing
rocks.

While it might be supposed that with the great extent of crystalline rocks in Canada, the presence of merchantable mica would be common over very large areas, or throughout their entire distribution, such, however is not the case. In fact it may be said that the mica-bearing belt is practically confined to a particularly limited area where certain kinds of eruptive rocks are readily recognized. Among the principal places where mica is found in large quantities, the following may be mentioned: A considerable district north of the Ottawa river along the lower portion of the Lièvre and Gatineau rivers and in the area adjacent for some miles; an area about the lower Rideau lake lying to the south and west of the town of Perth—the occurrences being mostly in the township of North Burgess—and a considerable area lying to the west of the Rideau canal, extending north from the village of Sydenham to the vicinity of Sharbot lake. In addition to these, several smaller areas are known in which local

Principal
mica areas

deposits of mica are found, but in none of them are the conditions so widely spread or the areas so large and generally important as in the three first mentioned.

Varieties.

Mica mining in Canada at the present day is practically confined to the phlogopite variety. A small amount of muscovite is occasionally produced, but the output may be regarded as insignificant compared with the large quantity of the former variety. Muscovite is usually known as a potash mica, and is a silicate of alumina with potash and a small percentage of iron with water; phlogopite is a silicate of alumina and magnesia and contains also potash and sometimes fluorine. Biotite is related to the latter but contains a marked percentage of iron in its composition to which the generally blackish colour is probably due.

Among other species lepidolite or lithia mica is occasionally found, generally in small quantities, and has as yet been neglected. With the phlogopites, portions which are usually known as cloudy or milky mica occur, but this apparently is of little commercial value.

Muscovite.

Deposits of muscovite are found at widely separated points. They are usually confined to dykes of a whitish pegmatite granite which cut the ordinary gneisses of the Laurentian.

Muscovite in
Quebec.

In the province of Quebec this species is known to occur at the following places, and in some of them it has been worked at different times with a certain amount of success.

In the township of Grenville, on lot 9, range VI, first alluded to by Sir W. E. Logan in his report for 1853, where he describes the occurrence of crystals measuring two feet by fourteen inches, specimens of which were sent to the Paris Exhibition of 1855. This deposit has apparently not been worked for many years. Its occurrence is also reported on lot 10, range V, and on lot 1, range X, of the same township, and further west in the augmentation of Grenville.

2. In Villeneuve township, lots 31-32, range I, the deposit opened by Mr. W. A. Allan in 1884 was mined for several years. At this place a large dyke of white pegmatite occurs along the bedding of grayish and reddish-gray garnetiferous gneiss which has a strike to the north-east with a westerly dip. This dyke has a width of about 150 feet, and the mica crystals, which are often of large size, occur on the western edge of the dyke, associated with crystals of tourmaline and of

several other minerals. Much of the mica is unfortunately affected by reddish stains of iron which seriously detract from its value, preventing the cutting out of large sized plates. Possibly in consequence of this imperfection the mine was closed some years ago. The associated feldspar in the dyke is often a clear white and has also been mined to some extent for shipment. It is of course possible that the character of the mica may improve at greater depths, but this has never been determined.

3. In Hull township, lot 7, range XII, it occurs in small quantity, but the deposit has never been opened to ascertain the extent. It is possible that other deposits may occur in this area among the pegmatites which are numerous at a number of points, but so far they have not been met with.

4. Along the lower St. Lawrence, in the townships of Bergeronnes, and at a distance of 20 to 30 miles below the mouth of the Saguenay, several deposits of this variety occur and have been opened up to some extent. Some of the crystals are of good size, cutting as much as 7 x 10 inches, though the percentage of this size is small, the average being about 4 x 5 inches. This location is about ten miles inland and was opened about the year 1892. Two mines known as the McGie and the Beaver lake are located here. A similar variety is also found in the townships of Escoumains and Tadousac. About 400 miles below Tadousac at Watsheshoo, muscovite also occurs but the extent of the deposit has not been ascertained.

At Lac Pied des Monts, about 17 miles north of Murray bay, it has been observed, and at Lake Manouan, about 250 miles north of Lake St. John on the portage to Fifth lake it was reported in 1885 by Mr. A. P. Low as occurring in large sheets or crystals with hornblende in a greyish green limestone interstratified with red gneiss.

In Ontario, muscovite occurs at several widely separated points:— Muscovite in
Ontario.

1. In Frontenac county, township of Miller, lots 4 and 5, range XI, where it has been mined at intervals for some years. Many of the crystals at this place are affected by iron stainings, and the locality is about 20 miles from shipment on the Kingston and Pembroke railway.

2. Further west in the township of Calvin, about ten miles west of Mattawa, one mile and a half north-east of Eau Claire station on the Canadian Pacific railway. The mineral here occurs at several places and has been mined to some extent. The mining was practically confined to an area on lot 19, range IX, but the plates produced seem to have been of small size and the work has been abandoned. The mica

occurs in a large dyke of pegmatite which cuts the gneiss, and a peculiarity noted at this place is the presence of a dark biotite in the same dyke.

3. On the upper Ottawa at a point about five miles above Pembroke on the Ontario side of the river, crystals of muscovite of large size were reported by Mr. A. Murray many years ago, as occurring, on what was then known as Montgomery's clearing, in a large dyke of pegmatite. This deposit has apparently never been opened up and the extent is therefore unknown.

4. At Yeo island, near the upper end of Tar island, one of the Thousand Island group in the St. Lawrence river where the mineral occurs, apparently in small quantity, with tourmaline in a pegmatite dyke. It does not appear to have been opened up and its economic value is probably small.

Among other localities where mica occurs, and has been reported by different observers, though the species is not clearly indicated, may be mentioned the following :—

Lawson, in Report for 1885, states that it is found in rather large quantities in the Lake of the Woods district, notably on Falcon island, in a pegmatite dyke which cuts gneiss and schist, the mica being in large crystals but injured to some extent by films of iron oxide. It occurs also on Sabaskong bay and on Big island, as well as on Rainy lake, the locality first named being the only one at that time worked.

Dr. Robert Bell in 1885, reported the presence of mica as occurring along the shores of Hudson strait, in specimens of good size, but the exact locality was not definitely ascertained, the Eskimos stating that it came from near Kimmirook. Specimens of beautifully clear white mica have also been handed me as coming from some part of the Labrador coast, but no definite information as to the point from which these were obtained was given.

On the shores
of Hudson
t.

Dr. G. M. Dawson reported the presence of mica, species not specified, as occurring in British Columbia, in veins in granite rocks in the vicinity of the north-east arm of Shuswap lake, the crystals being of large size; and also from a point about 120 miles north-east of Clinton.

The Ontario Bureau of Mines reports mica as occurring in the townships of Cleland, about twelve miles south-east of Sudbury, and also in the township of Gladman, about twenty miles north of Lake Nipissing. This mica is apparently of the muscovite variety, occurring in granite.

Phlogopite.

This mineral belongs to the class commonly styled magnesia mica, and in the *Geology of Canada* 1863, p. 494, it is stated that this variety is usually associated with the limestones of the Laurentian.

Since that early date however, the developments in the mica industry have been great, and the relations of the mica to the contained rocks are better understood. While phlogopite is almost always associated with pyroxenic rocks, which like the pegmatites, cut the containing rocks in all directions, it is very rarely, if ever, found in the limestone portion of the crystalline series. In certain portions of the pyroxenes, however, there occur large masses of carbonate of lime or calcite which form an integral part of the intrusive mass. This calcite varies in colour from almost white to a deep pinkish-red, and must be distinguished as a mineral, from the ordinary limestone formation. It is probable that a lack of proper separation of the limestone from the calcite first led to the statement as to its occurrence in the former.

Phlogopite mica is found at many points throughout the Ottawa district, northward and westward in the vicinity of Rideau lake, also in the belt of country north from Sydenham towards Sharbot lake, and in this direction some of the largest mines of this mineral in Canada occur in the townships of Loughborough and Bedford, between the Rideau canal and the line of the Kingston and Pembroke railway. Its mode of occurrence varies greatly in different places, but in so far as yet studied, the deposits may be classed generally under four heads.

1. As contact deposits, usually occurring near the edge of the pyroxene dyke and in close proximity to the associated gneiss which forms the ordinary country rock at most of the mines. The mica in this case follows down along the contact, and very frequently a mass of calcite, either pink or gray in colour is found through which the mica crystals are disseminated. Sometimes the calcite is replaced by large pockets of apatite, and when occurring in these minerals the mica crystals are usually in much better shape for cutting, than when they are scattered through the mass of the pyroxene, being as a rule, less broken or fractured. Frequently crystals of apatite and pyroxene are found in the same calcite mass with the mica, but at times these are practically absent. Crystals of mica are often found with included crystals of apatite, and sometimes with small inclusions of the calcite, these occurrences detracting greatly from the value of the crystals. As in the case of the apatite, mica occurring under these conditions may be found at almost any reasonable depth so long as the conditions

Mica-bearing
rocks.

Mode of
occurrence.

for its occurrence are favourable, and in fact mining has been carried down profitably on these contact deposits to a great distance as in the case of the Lake Girard mine in Wakefield township, which reached a depth of nearly 250 feet, in the Stoness or Buck lake mine to a depth on the slope of over 400 feet, and in other places to depths ranging from 100 to over 200 feet. These deep mines were all in contact deposits of calcite which sometimes formed pockety masses of great size. Sometimes the calcite is replaced in depth by apatite as in the Blackburn mine in Templeton township, and the mica occurs in this mineral in the same manner as it does in the calcite. A similar occurrence is seen at the General Electric Co.'s mine near Sydenham, where the calcite in the upper levels, apparently passes gradually into large bodies of apatite in the lower series of workings.

2. In pyroxene near the contact of cross dykes of diorite or pegmatite, the action of which on the former has often led to the formation of both mica and apatite. Numerous instances of this are seen in both the mica and apatite mines, and the crystals of both are often of large size and well formed.

3. In the mass of the pyroxene rock itself, distinct from the contact with the gneiss, the deposit following lines of fissure, often of large size and considerable extent. In this case, though the mica is frequently crushed and broken, large masses of crystals of fine quality and good size are found, the broken nature being sometimes caused by cross fracture and subsequent dislocation. As a rule, the deposits of this class do not appear to be so persistent as in the case of contacts. Some of the pyroxene masses are very large, as at the Cascades mine near the Gatineau, and at the Nellie and Blanche, lower down on the same river. In these cases the calcite is almost entirely absent, and apatite rarely occurs to any extent. When these masses are cut by cross dykes the conditions for both minerals are more favourable, and it is in this connection that the large masses of apatite are found along the Lièvre river. Often in deposits of this class the mica is found in irregular pockets, some of which are workable but in the smaller ones the crystals are often too much crushed to pay for their extraction.

4. In pyroxene dykes which cut crystalline limestone, and through which later dykes of diabase or pegmatite have intruded, as in the Quinn mine in Hincks township. At this place the crystals were of large size, occurring in the pyroxene near the pegmatite, but the mica is usually very darkly coloured, resembling a biotite. This is practically another form of class 2, the difference being chiefly in the character of the country rock.

Throughout both the Ottawa and the Rideau-Kingston districts the association of the mica and apatite is very intimate. There is, however, a marked difference observable in the mode of occurrence at different points. Thus in the area along the Lièvre, including the townships of Buckingham and Templeton in part, the apatite often occurs in large pockety masses in the pyroxene and has in places been worked downward by deep shafts along the contacts with the gneiss to a depth of some hundreds of feet, as at the North Star mine and in some parts of the High Rock group. In these areas mica is rarely seen ; but on approaching the mines north of Perkins Mill, comprising the Jackson Rae, the Blackburn and others around the shores of Wakefield lakes, the intimate mixture of the two minerals becomes very marked. In these areas the apatite is for the most part of the massive variety, while in the Gatineau district it occurs rather in the form of crystals disseminated through the calcite, and the massive form is rarely met with. The mica here becomes the leading mineral occurring in several ways but largely in calcite, while in the Templeton district it frequently occurs with the apatite which here replaces the calcite to some extent. This feature is especially well seen in the Blackburn mine which at one time was one of the largest producers of apatite in Canada, the mica being then regarded as a by-product of but small value, while at the present time the conditions are reversed and apatite which is extracted in mica mining is saved as a by-product, the mica being the mineral of chief importance.

Association of
mica and
apatite.

As an illustration of the growth of the mica industry it may be remarked that returns from Canadian mines were first published by the Geological Survey in 1886 when the value of the mineral extracted was stated to be about \$29,000. This figure was practically maintained till the close of 1889, when the rapid increase in electrical development opened a new market for the mineral, and in 1890 the value of the output increased to \$68,074. This in 1892 was further increased to \$104,745, after which there was a gradual decline for several years to 1898, when the demand developed very rapidly and in that year the value of the output reached \$118,375 ; in 1899 it rose to \$163,000 and the returns for 1901 were about \$160,000. The greater part of the output is exported. These figures are taken from the published Report of the Section of Mines of this Department.

Development.

In the province of Quebec phlogopite has been found and mined to some extent in the townships of Hull, Wakefield, Templeton, Buckingham, Portland, Aylwin, Hincks, Northfield, Bouchette, Wright, Alleyn, Cawood, Ripon, Litchfield and Grenville, but the principal mines

are located in the three townships first named. In Ontario the principal deposits are found in the townships of Loughborough and Bedford north of Kingston and east of the Kingston and Pembroke railway in the county of Frontenac; and in North Burgess and North Elmsley in Lanark county and South Burgess in Leeds. Its presence in greater or less quantity is also reported at a number of other points in this province, but so far little mining has been done outside of the Kingston and Rideau districts.

In most of these areas mica mining is subject to considerable fluctuation, owing chiefly to the irregular nature of the deposits in many places. Thus, a very fair surface showing of crystals may indicate merely a pocket, which when worked out often leads to the expenditure of much capital in the unsuccessful search for other masses, and the consequent abandonment of the place for a time. This condition is more often the case with pocket or fissure deposits in the pyroxene, the contact deposits being usually more regular and the conditions appearing to be more favourable.

The percentage of marketable mica obtained from most of the mines is never very large, owing to the fact that many of the crystals are too small or too much fractured or are otherwise too imperfect, to be cut to any but the smallest marketable size. Many of the large crystals are comparatively free from such imperfections but these are sometimes affected by sharp lines of fracture which divide the sheets into long and narrow strips, forming what is known as ribbon mica. Probably the amount of merchantable mica obtainable from the output of most mines will not average more than 10 per cent of cut sizes, so that in estimating profits, a large margin must always be allowed for waste material.

THE QUEBEC DISTRICT.

Mines in
Quebec.

Of the numerous mines opened and worked at different times in the townships of Buckingham and Templeton, practically the only ones now operated are those known as the Blackburn mine on lots 9 and 10, range XI, of the latter township; the Wallingford mine on lot 16, range VIII; and several new openings near the shores of Battle lake, owned by the latter company. The two first come under the head of contact deposits, the latter are in part contacts and in part fissures.

At the Wallingford mine near Perkins Mills, work has been carried on for some years. The old pit which reached a depth of about 150 feet, was abandoned several years ago, after producing a very large

amount of excellent mica, much of which was in large crystals, and a new pit has been opened a short distance to the south. The country rock at this place is a reddish and gray gneiss with granite, cut by pyroxene dykes which have a general direction of north-east and south-west, with an inclination in places to the south of 70 to 80 degrees. The new pit opened several years ago is now down to a depth of 100 to 120 feet, and the mica is found with green apatite, the latter sometimes in large quantity, along the foot wall of the dyke in a fairly well-defined zone. While a large proportion of the crystals mined are somewhat small, and in parts badly crushed, crystals of large size also occur quite abundantly. The apatite is saved as a by-product, and the price of this mineral, for No. 1 grade, is now said to range from \$8.00 to \$10.00 per ton. Openings to the south of the main pit on the present worked dyke also show mica and this may represent a contact deposit on the other side of the pyroxene, but the central mass of the intrusion is barren in so far as yet tested. The width of the mica zone now worked on the foot wall is from three to six feet. Calcite is found in small quantity, but in this mine it appears to be in part replaced by apatite.

In the Blackburn mine on lots 9 and 10, range XI, Templeton, some facts were observed. This place has been almost continuously mined for many years, first for apatite, and the two minerals are intimately associated. The workings have been carried down in a large open cut to a depth of about 250 feet with a large drift at the east end. Calcite is sometimes seen, but is apparently largely replaced by apatite in which the mica crystals are abundant, and frequently of large size, some of them cutting 5 x 14 inches, and it is stated that about 30 per cent of the output is saved for the market, which is a somewhat large proportion.

The apatite appears to occupy the north side of the pyroxene, which is in a large mass, the gneiss in contact being seen on the north wall, and the conditions appear quite uniform to the lowest level worked. In the sides and roof of the main cut, and in the long drift to the south-east the mica crystals are thickly studded, often lying solidly packed together in the apatite with which calcite sometimes occurs. The country rock is the usual grayish and reddish-gray gneiss, and the pyroxene dyke cuts across the stratification.

On the north side of Battle lake, in the mine recently opened by the Wallingfords, there is a large mass of the pyroxene cutting the usual character of gneiss with some quartzite. Other smaller dykes of the pyroxene are seen, and in these the mica crystals are developed

along fissures or as small pockets. No calcite is visible in the principal opening, but small quantities of apatite are scattered through the mass. Some of the crystals are of large size, as much as sixteen inches across the face, but the bulk of the output so far obtained, is only suitable for cutting into the smaller market sizes. The pit is, however, not more than 20 feet deep and the deposits may improve at greater depths.

The pyroxene at this place is generally soft, and often filled with small mica scales forming a mica-pyroxene. Where calcite is seen, it follows along thin seams in the rock.

To the north of this in the direction of Lake Rheaume other masses of pyroxene occur cutting the gneiss, in some of which apatite is abundant, sometimes in the form of sugar phosphate, carrying mica crystals; in other places the mica is found in the calcite with masses of apatite crystals after the manner of contact deposits. None of these openings have been developed to any considerable extent for mica, as the mining formerly done was on the apatite.

In the apatite areas adjacent to the Lièvre, such as the High Rock group and those north to High Falls, situated on the west side of the river, mica has not yet been found in quantities of economic importance. In Portland east and in Derry townships on the east side, several deposits have been opened and mined to some extent. The largest of these areas is that owned by the Glen Almond Co., on lots 1 and 2, range I of the former township, where a considerable amount of development has been done and a large quantity of mica, generally of the small sizes, has been obtained. These mines are not at present being worked.

THE GATINEAU DISTRICT.

Mica is found along the course of the Gatineau for at least 150 miles from the mouth, but the principal mining locations do not extend for more than half this distance.

Among the first locations where mica mining was developed in this area may be mentioned the group situated near Wilsons Corner about six miles east of the river near the line between the townships of Hull and Wakefield. The country rock is generally reddish-gray and gray gneiss with occasional limestone bands. Intrusions of pyroxene, pegmatite, hard dark diorite, and gabbro are very frequent. The full descriptions of these areas are given in the report on the Grenville sheet, No. 739 of the official list of publications. The principal points of interest will only be stated here.

Among the mines of this group to the west of Wilsons corner may be mentioned lot 16, range I, Wakefield; lot 12, same range, (Hughes and Haldanes); lot 14, range XVI, (Horse shoe mine), all of which have been abandoned for some years. The mica in these mines occurs usually with calcite and sometimes apatite, in the form of contact deposits in pyroxene near the gneiss.

On the south side of the road, other mines occur which were at one time worked to some extent. These include lot 12, range XVI, Hull, (McLelland's); lot 13, same range, (Wilson's); and lot 12, range XV, (Chubbuck's). At the first named, serpentine is found with the pyroxene and the crystals are sometimes brownish or purple tinted. On lot 13, range XVI, large crystals of amber mica were found, as well as of pyroxene. Most of these deposits are of the contact class, but no work has been done on these properties for some years.

To the north of Wilsons corner, mica has been worked on lot 14, range II, Wakefield; lot 16, same range, (Chubbuck and Wilson); lot 18, same range, (Seybold's); in all of which the deposits are of the contact class, the only locality at present worked being the second named.

The deposit on lot 16 was first opened in 1892-93 and examined in the latter year by the writer. Since that date a large amount of development work has been done, principally under the direction of Mr. Chubbuck of Ottawa, and the following remarks as to its present condition may be made. The property is now known as the Kodak mine and as an illustration of the character of contact deposits its study is interesting.

The mica occurs along the contact of a large dyke of green pyroxene with the grayish gneiss, and is associated with a mass of pink calcite which has a thickness varying from three to fourteen feet. In this respect the conditions are very similar to what were seen at the Lake Girard mine, for some years one of the largest producers of mica in the Ottawa district. The mica crystals are generally found in the part of the calcite adjacent to the pyroxene, but sometimes in the outer portion of the pyroxene itself, and the deposit has been opened up along the line of the outcrop for a distance of some 600 feet, by a series of eight or ten pits with depths varying from 15 to 50 feet, and by a shaft to a depth of 150 feet. Many of the crystals are of large size and excellent quality, occurring in pockety bunches or masses which are continuously exposed to the bottom of the shaft. The character of the deposit appears to be fairly uniform throughout its entire development along

the line of strike, and the masses of crystals have a thickness in places of from three to six feet.

The mine is well equipped with an electric plant for lighting and for pumping, which is driven by water power obtained from Blackburn creek which crosses the property and is sufficient for all purposes of development. The mine has produced a large quantity of excellent mica during its period of working. This is roughly dressed at the surface and then hauled to Ottawa where it is trimmed and prepared for the market. This mine, with that known as the Nellis mine on lot 10, range XI, Hull, are two of the most important in this district.

To the south, on the road from Wilsons corner to Ottawa, several mines are located, including lot 10, range XI, Hull, (Gemmill or Nellis); lot 10, range XIV, (Webster's old mine); lot 1, range XIII, (Burke's); lot 3, range XIII; lot 9, range X, (Nellie and Blanche); these are all of the contact class except the last which is a fissure deposit. Of these the Nellis mine has been worked for some years almost continuously and has been a large producer of very excellent mica.

Nearer the Gatineau is the Cassidy mine on lots 15-16, range XV, Hull, a fissure deposit worked for some years, but also abandoned after producing a large amount of mica, some of which was in large and fine crystals; and the Macfarlane mine to the north which is a contact deposit opened to some extent, but like many others in the district abandoned.

West of the
Gatineau
river.

West of the Gatineau, and near Kingsmere, the following mines are located in the township of Hull. Brown's mines on lot 19, range VII, Hull; Fortin and Gravel on lot 18, and the Fleury mine on lot 20 same range. The rock at these mines is reddish and gray gneiss with bands of crystalline limestone, and numerous dykes and masses of pyroxene occur. At all these mines the mica occurs as contact deposits with bunches of calcite and some apatite, the latter as crystals, and the mica is sometimes in large clear crystals. The Fortin mine has been worked to a reported depth of nearly 100 feet.

On the road from Old Chelsea to Kirks Ferry, the Scott mine is on lots 14 and 15, range IX, not worked for the last ten years, and on lots 15 and 17, range X, several openings have been made on small surface showings of mica which have never been worked to any considerable extent.

Near Kirks Ferry, on lot 12, range XI, (Haycock's), some mining was done about ten years ago, and on lot 14, range XI, (Connor's), a number of openings were made about the same date, with fair surface

showings at different points. The uncertainty of these deposits was apparently the cause of their abandonment.

On lot 23, range XI, (Moore or Wright mine), a short distance above Cascades, there is a large mass of pyroxene, from which considerable mica was at one time obtained from fissure deposits. But little calcite or apatite was observed in any of the openings near this place, which are made over a large area.

Further north, in the township of Low, lot 36, range XIII, is the Venosta mine, from which some large crystals were at one time obtained, but which has been closed for ten years or more. In Hincks, lot 22, range II, the Quinn mine, worked by Powell and Clemow about ten years ago, produced a considerable quantity of large dark coloured mica and was then abandoned. In Wright township, lots 14, range D, the Guay mine was an extensive producer for several years and reached a depth of nearly 100 feet, the output being of excellent quality. At this depth the mica is said to have become exhausted. This was a good illustration of a contact deposit. In the township of Bouchette, lot 31, range I, a large deposit of mica in pyroxene cutting gray and rusty gneiss was worked for a time, but the mineral was of the dark variety, and the mine has been abandoned for some years. Most of these mines were on contact deposits.

Around the Wakefield lakes in the townships of Portland west and of Templeton, several apparently large deposits were operated some years ago. The remoteness of the mines from the railway necessitates expense in shipment and no work has been done in this area for some years.

Among the principal mines in this district are the McRae, on lots 26-27, range IV, of the former township, the mica occurring in pink calcite with both red and green apatite; the Laurin mine, lot 20 range XII, Templeton, and the Templeton and North Ottawa Co., lot 21, same range. In all these places the mica is closely associated with apatite and there are numerous intrusions of pegmatite and pyroxene in the red and gray gneiss. No work has been done on these areas for some years.

Among other localities in which mica occurs, north of the Ottawa and west of the Gatineau, may be mentioned the township of Huddersfield near the outlet of Moose lake, where a hard pyroxenic dyke cuts gneiss and carries a small amount of dark mica with pink calcite. Attempts to mine this profitably have not yet been successful. In Litchfield, lots 20, 22, 23, range IX, several miles in rear of Camp-

bells bay a quantity of dark mica has also been found, apparently not of good quality as but little attempt has been made to work the deposit.

Similar small deposits have been found in lots 7-8, range A, Waltham.

Pickanock
area.

Near the Gatineau in Wright, about one mile south of the Pickanock river, close to the post road, is Moore's mine with a fair showing of small sized crystals, which has been opened to some extent, and further south on lot 6, range A, a deposit opened up by Mr. T. J. Watters some years ago, has been taken over by the General Electric Co., under the name of the Shibeer mine and is now being developed with a diamond drill and by shafts with promise of a large output, as the mica has improved in depth. These are both contact deposits. On the east side of the river in Northfield, lot 3, range A, a Toronto company opened some pits several years ago on dykes cutting gray gneiss, but the output was generally of small size and work was soon stopped. Another opening was made on lot 13, range B, in the same township, but little mining was carried on.

In the township of Alleyn, near the Kazubazua river, on lot 10, range II, a large deposit of excellent mica has been worked by Mr. Joshua Ellard of Wright post office. The country rock is a gray gneiss with limestone, cut by pyroxene, and the mica is found in calcite as a contact zone of two to three feet in width. Several hundred tons, of excellent quality, have been extracted.

Openings have also been made on lot 12, range I, in calcite, but the mine has not been worked for several years. On lot 4, range II, on Mrs. Mullingham's property, operated in 1898-1900 at intervals, the pyroxene traverses a red granite and the mineral occurs with a little apatite and calcite.

In the township of Cawood, lots 23-24, range III, some good and nearly white mica was obtained in 1897, and the pit was worked for a short time in the following year. On lot 41, range V, about 20 miles north of Shawville, a small quantity of good amber mica was obtained in 1898, but nothing has been done recently.

On lot 12, range VI (Priestly mine), some exploratory work was done on pyroxene cutting a gray granite and a small amount of amber mica was obtained.

On lot 18, range VI, (Brock and Pritchard) a deposit was worked for a time at intervals in 1898-99. Some good crystals were obtained

but nothing has apparently been done recently. The country rock at this place is largely a red granite cut by pyroxene, carrying calcite.

Mica is also reported from lots 17 and 22, range VII, Low township and from lot 53, range VII, Aldfield. Also from lot 14, range I, Clarendon, and from lot 51, range III, Thorne, from which several tons were taken.

Among the largest and at one time, most important of the mica deposits in the Gatineau belt is the Lake Girard mine on lot 24, range II, Wakefield. As an illustration of a contact mine it may be specially mentioned.

The country rock here is grayish and reddish-gray gneiss with several bands of crystalline limestone. About 120 paces back from the shore of the lake a large dyke of pyroxene cuts across the gneiss, and on this the mine is located along the foot wall or contact. The excavation has been made to a depth of about 250 feet, and large masses of pink calcite are found in the margin of the pyroxene through which the mica is disseminated in large pockets of crystals, some of which are of fine quality as regards size and clearness. In places, however, the calcite is quite barren. But little apatite was found in the mine, and at the lower levels the mica disappeared, the calcite forming large masses. This disappearance of mica in calcite when the latter reached large proportions has been noticed at several other places. It is possible that along other parts of the contact similar large deposits of mica occur, but at present the mine is closed.

In addition to the above descriptions which comprise the principal deposits in the area north of the Ottawa, mica has been found at a number of other points which may for the sake of reference be mentioned.

In Templeton township, in addition to those already stated :—

Mines in Templeton.

Lot 21, range IV, indications only. (McTierny).

Lot 22, range IV, (Taylor and McVeity), an old apatite mine, reopened for mica in 1898, and a considerable amount extracted.

Lot 20, range V, (W. Smith). Indications.

Lot 10, range VII, (Stevenson mine), worked in 1899, by Mr. J. Asquith of Ottawa, by a surface trench which is said to have yielded a large quantity of good mica.

Lot 14, range VII, (American Mica Co., Boston).

Lot 15, E. 1-2, range VII, worked in 1891 by Hon. C. A. Dugas, in 1896-97 by Baumgarten and Manchester, and later by the Webster Co., to a depth of 50 feet. Some good mica was obtained.

Lot 15, W. 1-2, worked by several parties since 1893; and in 1897-99 to a depth of 70 feet. Reported to have produced a large quantity of excellent mica, some of it of large size.

Lot 4, range IX (Sophia mine), worked at intervals since 1892, producing a large amount of good merchantable mica.

Lot II, S. 1-2 (North Templeton and Ottawa Mining Co.), prospected in 1894; no information as to results.

Lot 13, same range; indications.

Lot 14, same range. Worked for apatite twenty years ago, and since 1894 for mica, which occurs with the apatite and pink calcite. In 1899, worked by Jurkowsky and Co.

Lots 16-21, also prospected by same company; no returns.

Lot 7, range X, prospected in 1900 by McLauren and McLaren.

Lot 8, same range (Marsolais mine). Formerly worked for apatite, but since 1897, has been worked at intervals for mica, of which a considerable amount has been taken out.

Lot 9, E. $\frac{1}{2}$, (Post mine, Canada Industrial Co.) formerly worked for apatite, but recently for mica, some crystals of large size being found.

Lot 9, W. $\frac{1}{2}$, (Jackson Rae mine), formerly worked for apatite, but since 1892 has yielded a considerable amount of mica. Some of it of good size.

Lot 10, N. $\frac{1}{2}$, (Jubilee mine), formerly worked for apatite, but like the last contains mica in considerable quantity in association.

Lot 10, E. $\frac{1}{2}$, contains both apatite and mica.

Lot 15, W. $\frac{1}{2}$, both mica and apatite; small quantity produced.

Lot 16, (Victoria mine), opened in 1899 by McLaurin and McLaren for 300 feet in length by 60 feet in depth, and has produced a large amount of apatite and mica of excellent quality.

Indications of mica are found, but apparently not yet developed, on lots 12, 13, 14, 24, 27, range XII, and on lots 3, 4, 5, 13 and 17, range XIII, as also on lot 38 of the Gore.

In the township of Hull, in addition to those already mentioned, are the following, some of which have been opened and worked.

Lot 23, range XV, (Ferguson mine), opened in 1899 by Mr. Flynn, ^{Mines in township of Hull.} a contact deposit in calcite and pyroxene, which has yielded a fair amount of medium and small sized mica.

Lot 25, range XV, (Moore mine.)

Lot 27, range XVI, (Gorman mine) opened in 1898 by Mr. Bishop of the Cascades, has been worked at intervals, for some time.

East of the Gatineau river are the following.

Lot 7, range X, (Foley or Big Crystal mine) closed since 1898.

Lot 5 and S. $\frac{1}{2}$ lot 6, range XI, (Kearney mine) worked in 1892 by Rae and Allan. The Eureka mine on lot 6, same range, worked in 1893 by Mr. Perkins.

Lot 12, north $\frac{1}{2}$, range XV, (Dacey mine), worked in 1898-99 by Webster & Co., to a depth of about 50 feet with a considerable output of rather small mica.

Lot 13, south $\frac{1}{2}$, same range, opened and worked as an apatite mine, but reopened in 1893 by Clemow and Powell for mica.

Lot 13, north $\frac{1}{2}$, James Connors, worked by Webster & Co. in 1892 and by the owner in 1899. Small quantity only reported.

Lot 15, east half, same range, (Jameson mine), worked for several years to a reported depth of 75 feet; some mica of large size obtained.

In the township of Wakefield mines exist in addition to those ^{In Wakefield.} already mentioned on :—

Lot 15, range II, (Comet mine) worked in 1898-99.

Lot 16, same range, (Kodak mine) formerly Chubbuck and Wilson, worked to a reported depth of 110 feet along a distance of 200 feet, from which a large quantity of good mica was produced, and in 1900 also worked for a time by Jurkowsky & Co. and by Webster & Co.

Lot 17, range II, (Morris mine) opened in 1892, has produced some very large mica.

In the township of Portland west :

In Portland.

Lots 12 and 13, range III, (Lake Terror mine).

Lot 15, same range, opened in 1900, produced a small quantity of good mica.

Lot 24, N. $\frac{1}{2}$, (Lila Mining Co.) worked in 1899 as an old apatite mine which yielded also some fine mica crystals.

Lots 26, 27, 28, range IV, (Fleming and Allan), once mined for apatite, were reopened in 1891, and produced a considerable quantity of good crystals.

Lots 5-6 (McIntosh mine), formerly worked for apatite, has also yielded some mica, quantity unknown.

In the township of Portland east :

Lot I, range I, (Judge mine) opened first 1893, reopened 1899, area adjacent to the lots of the Glen Almond Co.

In Derry the Glen Almond Co. has done some mining on lot 23, range II, and on lots 3, 4, 6, range III.

Lot 9, range I, opened by W. A. Allan in 1900, a few tons taken out from surface workings.

In Buckingham, lot 25, north $\frac{1}{2}$, range IV, mined in 1899 by Mr. Tetreau and in 1900 by Mr. D. Richard. Some small mica obtained.

South March
mines.

In the area south of the Ottawa, near South March station on the Canada Atlantic railway, and to the north-west of Carp station several deposits of mica, with which is associated small quantities of apatite, are found. The country rock is the usual gray and red gray gneiss which is cut by masses and dykes of a hard dark gabbro or pyroxenic diorite, in which the mica occurs. The crystals are sometimes of good size, but very dark coloured like a biotite, and usually hard and somewhat brittle. This renders them practically of little use for cutting into thin sheets, but when weathered for a time they become more elastic. But little economic importance has as yet been attached to these deposits by dealers in mica, and work has been suspended for some years.

THE PERTH DISTRICT.

North Burgess
township.

The mica mines in this district are for the most part confined to the townships of North Burgess on the north side of the Rideau lake and to South Burgess, on the south side. The rocks are of the usual type of grayish and reddish gneiss with quartzite and bands of crystalline limestone.

In the former township the occurrences of mica are numerous, and some of the deposits are extensive and valuable. Most of the areas were originally mined for apatite, and very full descriptions of a number of lots on which the minerals occur are given in reports by Mr. Gordon Broome, 1870-71, pp. 316-321, and by Mr. H. G. Vennor,

1873-74, pp. 110-139. From these descriptions it would appear that in nearly all the lots there mentioned from nos. 1 to 13, on ranges IV to IX, the association of mica and apatite is very intimate, though at the time of these reports but little attention was paid to the former mineral. From the presence of pyroxene dykes which cut the gneiss, and the occurrence of pink calcite at most of the openings it may safely be inferred that the greater number of these deposits occur as contacts. The apatite is found sometimes in the form of crystals disseminated with the mica in the calcite, and sometimes as irregular pockety masses, which were called veins, along the outer margin of the intrusions.

Some of these mines were opened nearly forty years ago, and a large amount of apatite was extracted prior to 1890. The mica being regarded as of but small value, owing to the lack of a market, though several deposits of this mineral were even then worked for a short time to a limited extent. The small demand for mica did not apparently warrant the expenditure of much capital in the development of this industry; but about fifteen years ago attention was turned in this direction and since that time a number of mines have been opened, some of which have proved fairly profitable, though, owing to the uncertain nature of the deposits, many of them have been abandoned entirely or are worked at irregular intervals.

Among those which may be mentioned as occurring in the Rideau-Perth district in the township of North Burgess are the following;—

Mines in
North
Burgess.

The Hanlan mine, now a part of the General Electric Co's system, lot II, range VI, the mica occurring in apatite or calcite the former often iron-stained; a contact deposit. The country rock here is a grayish and reddish-gray quartzose gneiss which is cut by a number of pyroxene dykes with a general course of N. 15° 20° E., varying in width from 4 to 10 feet. About 150 yards west of the present main pit a number of old openings are seen from which small quantities of mica have been obtained. These workings are all shallow. The old Webster pit is about 300 yards south-west of the present workings. In most of the openings calcite and a small quantity of apatite can be seen and they are all clearly contact deposits.

At the pit now being worked by the General Electric Co. a shaft has been sunk to a depth of about 100 feet near the under side of a large dyke of pyroxene, which has a general course of N. 40° E. From the foot of the shaft a drift has been run along this foot-wall in the direction of an open cutting which lies to the north-east. The width of the mica-bearing zone at this place appears to be from 5 to 8 feet

and the crystals are disseminated in calcite which increase in volume below the 60 feet level. Many of the crystals are large and clear, ranging in size up to 14 × 18 inches on the face. The mica from the upper portion of the mine is usually of the smaller sizes, so that the quality improves as lower workings are reached. The area has been proved by diamond drills and the mica found to be continuous in depth. Apatite crystals occur with the mica in the calcite which varies in colour from a creamy white to a deep pink. This mine is a fine illustration of a true contact deposit. Coarse grained, somewhat purple and greenish-gray gabbro dykes cut the quartzose gneiss in the vicinity of the mine as well as on the lot adjacent to the north, where also the calcite appears in considerable volume and is being proved with a diamond drill. Red granite masses are frequently seen, all of which are newer than the crystalline limestone of the area, which overlies the gneiss. The output is hauled to Perth, nine miles distant, and the mine is well equipped with a hoisting and pumping plant, as well as drills.

This mine is the only one in active operation at the present time, in this district.

Lot 13, E. $\frac{1}{2}$ range VI, (The Martha mine) was worked for some time with shafts to a depth of 100 to 130 feet.

Lot 11, range V, (the Baby mine), was also worked by shafts to a depth of 130 feet.

Lots 11 and E. $\frac{1}{2}$ lot 12, range VII, (Byrnes mine) worked some years ago to a depth of about 80 feet.

Lot 4, range VI, (Watts and Noble mines).

Lots 16-17, range IX, (Pike lake mines), said to be the oldest mica mine in Ontario, was worked by several shafts from 55 to 90 feet deep. This mine is in a large mass of pyroxene and seems to belong to the class of fissure deposits rather than to the contact variety.

Lot 10, range V, (Blackhall mine).

Lot 21, range VI, (McNally mine).

Lot 12, range VI, (Old Adams mine).

Lot 4 range VIII, (McLaren mine), worked for both apatite and mica.

Lot 12, W. $\frac{1}{2}$ rang VI, (Munslow mine) adjacent to the Martha,

Lot 16, range V, (Donnelly mine).

Lot 7, range VIII, (Adams mine).

The Noble Bay group of mines is situated near the shore of Rideau lake, and comprises lots 2, 3, 4, 6, 7, 8, and 9, range V; lots 7 and 23, range VI; and lot 24, range IV. Considerable surface mining has been done at several points, but all are for the present abandoned. In so far as examined the pockets are somewhat irregular and the mica is of the smaller sizes.

From the descriptions given by Mr. Vennor of many of the mines mentioned above it would appear that the greater number may be classed as contact deposits. In the vicinity of Otty lake, where several of these are located, the mica does not appear to occur in such well defined masses as in other areas to the west, the apatite having the larger development. It is of course possible that deeper mining would establish the presence of larger bodies of mica at lower depths, as has been found to be the case in other places, but this is a matter for underground exploration and the judicious expenditure of capital. In all mica mining there appears to be a large element of uncertainty as to the continuance of mining conditions, and small companies with limited capital are rarely in the position to obtain the best results as to the extent of the mica deposits in any area. In several cases mines which have thus been abandoned through lack of capital have been opened under different management and proved to be good producers, as the conditions frequently change for the better as well as for the worse.

On the south side of Rideau lake, on lot 1, ranges III and IV, ^{South Burgess.} South Burgess, there is also an interesting development of mica. This was worked quite extensively some years ago under the name of the Cantin mine, and when examined in 1896 had a depth of 100 feet in the principal opening, the mineral occurring as a true contact deposit in calcite, from which large quantities of excellent crystals were obtained. At this depth, however, the mica zone was cut off by a mass of red granite, and after some time spent in a search for its continuation the area was abandoned. Whether the cut-off was due to a fault or to a later intrusion of the granite could not then be ascertained. This property has recently been acquired by the General Electric Co. which proposes to develop the area by means of a diamond drill, in order to ascertain this point.

The country rock at this place includes large areas of crystalline limestone which are cut by both granite and pyroxene. In the dumps there is a large quantity of pink calcite.

On this side of the lake also near the head of German bay, several openings have been made on pyroxene-mica dykes which cut red and gray gneiss, but the mica showings are small and the development work is limited. Along the shores of the lake also several shallow pits have been sunk in similar rock but without showing workable mica.

On the north side of the lake on the east side of Bass bay, the rocks are gneiss and quartzite with red granite cut by dykes in the usual manner, and a number of small openings have been made and some small mica extracted, but work has been suspended here for several years.

As a general statement therefore, it may be said that in the Rideau district the greater part of the mica occurrences may be assigned to the contact class. As a rule the rocks are practically the same as seen in the Gatineau area, with which the rock formations are continuous beneath the overlying Palaeozoic formations and the conditions for mica are practically the same in the two districts.

THE DISTRICT NORTH OF KINGSTON.

Mines of the
Kingston
Rideau dis-
trict.

In this district may be described several widely separated mines which occur mostly in the area between the Rideau canal and the Kingston and Pembroke railway. They are found in the Townships of North and South Crosby, in Bedford and Loughborough. Some of these were originally mined for apatite, but on the closing of that industry were reopened for mica and have for several years produced large quantities of very excellent quality. The country rock in all cases is the ordinary gray and reddish-gray gneiss with occasional masses of quartzite and bands of crystalline limestone, with which are associated red and sometimes gray granite and pegmatite, while pyroxene is abundant in many parts of the area. The formations are similar to those north of the Ottawa already described.

On lot 14, range VI, South Crosby, is McLaren's mine. This lot was opened up about 20 years ago for apatite and worked for a short time. In 1900 it was reopened for mica. The surface rock about the mine is a hard dark-gray or sometimes blackish diorite with pyroxene, but the usual rock of the ridge on which the mine is located is a reddish-gray granite and gneiss.

On following down the apatite it was found to become associated with mica in considerable quantity, the width of the deposit ranging

from 8 to 10 feet in places near the west side of the pyroxene dyke. Much of the mica seen at the time of our visit in 1901 was in large-sized crystals, some of them measuring 12 x 16 inches but somewhat dark in colour. In places bunches of pyrite came in near the edge of the dyke and when in contact with the mica the latter became rotten and discoloured. The pyrite sometimes passes into a red haematite. Small bunches of pink calcite are found with the mica and both red and green apatite in small amount at a depth of 20 feet which was that of the pit when we examined it. Though a considerable amount of mica was extracted, the mine has since been closed. The occurrence of the pyrite at this place and its injurious action on the mica is an interesting circumstance.

Near the line between the townships of Storrington and Bedford Opinicon lake. on the north side of Opinicon lake are the Smith and Lacey mines which have been extensively worked at intervals for several years. The mica is of a light amber colour occurring in pyroxene dykes which cut a gray and sometimes rusty gneiss, and is associated with a light green mineral resembling a feldspar, but no pink calcite was seen. The mica appears to occur as fissure deposits near pegmatite intrusions, and a large amount has been taken out, much of it of large size and good quality. At the old apatite mine on the east side of this lake, near the outlet from Crow lake but little mica was observed. Along the shores of Rock lake also small shows of mica have been reported but nothing has been done in this direction.

On Buck lake, which is about four miles west of Opinicon lake, Buck lake, Bedford. there are several mica mines, one of which was worked for a number of years and has been a large producer. This mine is on lot 3, range XII, Bedford, known as the Stoness mine, and belongs to the contact class, the mica being in pyroxene which cuts the grey and reddish gneiss. There are a number of these dykes in the vicinity. Crystalline limestone occurs abundantly on the shore of the lake near the mine and is cut by white pegmatite. The pyroxene in which the mine is located is a light green variety with great masses of pink calcite, through which the crystals are disseminated, sometimes in pockets of large size, and the dump from the mine is largely of this calcite with masses of the light green pyroxene.

The workings were carried on by means of a shaft or slope sunk to the north-west for about 400 feet at an angle of about 30 degrees, the general strike of the gneiss in the vicinity being N. 30° E. A heavy dyke of dark diabase cuts across the gneiss and pyroxene a short distance west of the main opening with a thickness of about 15 feet which was

passed through in sinking the slope. In the workings, large masses of pink calcite were encountered, occurring after the manner of the great apatite pockets in the Ottawa district. The diabase dyke cut off the mica zone which was however resumed after passing through the intrusive mass. The pyroxene cuts the gneiss at a rather sharp angle. In several of the other dykes mica with calcite was found, but in some, no calcite was visible, in which case the mica is in the form of fissure deposits, occasionally in considerable quantity, but often ending abruptly in small fissures with crushed crystals. Sometimes the mica terminates abruptly through the agency of later diabase intrusions.

In the area between the foot of this lake and the road along the shores of Clear and Devils lakes pyroxenes were observed at a number of points, some of which have not been developed to any extent. The calcite at the bottom of the deep shaft is reported to have become almost barren of mica, resembling in this respect the Lake Girard mine, and the quantity of the calcite was such as to be excavated into large chambers.

Tett's mine,
Bedford.

Another interesting mine in this area is that on lot 4 range VIII, Bedford, known as Tett's mine. Here the country rock is a grayish and rusty gneiss with some limestone, having a strike of N. 60° E. with a dip to the north-west. This is cut across at an angle by a heavy dyke of light green pyroxene which is, in turn, cut by a very hard grayish-green fine grained granite. The mine is opened by a series of pits along the course of the dyke. In most of these there is no showing of the calcite, but in a couple of the eastern pits there is a small quantity. The mica occurs at or near the contact with the rusty gneiss and large crystals of pyroxene as well as of mica are found.

Iron pyrites occurs in bunches, as at the McLaren mine in the harder portions of the pyroxene and has adversely affected the mica, making it rusty in places. The course of the intrusion is N. 55° E. as indicated by the line of pits, but owing to most of these being filled with water at the time of our visit, in 1901, the conditions of the lower workings could not be studied. Most of the mica extracted had been removed, but the output is reported as of large size and good quality. A small band of impure limestone is seen along the south side of the openings and small quantities of apatite were observed at several points.

Further to the north-west on the shore of Mud bay which is an arm on the north side of Bobs lake, on lot 30, range VI, Bedford, a somewhat important deposit is now being mined by Mr. Stoness and others,

on what was formerly known as the Taggart mine. There is here an extensive development of pyroxene cutting grayish-red gneiss with granite masses. Some portions of the former are hard and dioritic, others are soft and light green. A number of openings have been made at this place, and the new developments were commenced in the summer of 1903. The mica veins are exposed along a general course of N. W. and S. E. and are for the most part either pocket or fissure deposits. In places the mica zones have a thickness of three to four feet but others are much less. There is no calcite as a rule, but apatite is found in small quantity in the largest opening, which in Sept., had reached a depth of 30 feet and was about 40 feet in length, the mica following along the north side of a hard pyroxene rock, in which the softer portions carried the crystals, generally of small size, cutting 4 x 6 inches and less, the larger sizes being in irregular pockets. The mica is a rather dark amber, but comparatively free from imperfections.

On the opposite or northern side of Mud bay there is a considerable development of crystalline limestone and gray gneiss, cut by pyroxene, in which deposits of apatite were quite extensively mined some years ago.

On lot 2, range V, Oso, near the head of Crow lake, several openings have been made in pyroxene dykes which cut the gneiss at a sharp angle. The principal openings are on a dyke about six feet wide and the mica occurs on the west side in deposits of calcite. Apatite occurs also in small quantity, and the locality was at one time worked for this mineral.

The general course of the dykes is about N. 15° W., with a dip sometimes to the west and sometimes to the south-east. The mica vein in the principal opening is disclosed for about 50 feet in two pits but a good deal of the mica is crushed. About 150 feet west of this opening another smaller dyke has been opened and a similar occurrence of mica can be seen. These are both good illustrations of contact deposits. Further to the east mica also occurs under similar conditions, but no work has been done here for some years. The output from the Bobs lake mines is hauled to Olden station on the Kingston and Pembroke railway.

In the vicinity of Sydenham lake and on several of the lakes to the north, there are a number of interesting mica deposits, among which the largest and apparently most important is that known as the old Smith and Lacey, now the property of the General Electric Co. of Schenectady. The mine is on lot II, range VII of the township of Loughborough. ^{Loughborough mines.}

General Electric Coy's mine.

This mine is noted for the size and excellent quality of the crystals extracted, some of these having dimensions of over seven feet in length and one has been found of over nine feet in length.

The knoll on which the mine is located is rather more than a fourth of a mile from the east side of the narrows which connect Sydenham lake with Eel lake, and is intersected with dykes of pyroxene, some of which are large. The principal workings at present are on the north side of a large dyke which has a general course of north-east, cutting at an angle across the country rock which here is a brownish or gray mica gneiss, associated with crystalline limestone which shows in a large body to the south. The strike of the gneiss is about N. 30° E. and the dip to the north-west.

The pyroxene at this place varies in character, some of it being light-green, soft and filled with small mica scales; other parts are hard and dioritic, altering in places to a true pyroxene. In the main pit of the General Electric mine, the mica, which is on the northern side of this intrusion, occurs in a soft portion of the dyke which passes down into the hard dioritic mass in which the mica is absent. The crystals are associated with large masses of calcite varying from pink to gray, but the mica zones are large and generally along the course of the dyke wall, forming a well defined contact deposit, with side veins which are of the nature of fissures.

The width of this dyke has not yet been definitely ascertained. Where the mica is found on the northern edge, the dip of the contact is north at an angle of eighty degrees. In part the mica is mixed with a white calcite but at about 115 feet down this calcite is largely replaced by green apatite in which the crystals are found, and in places both the calcite and apatite are intimately associated. In another part of the deposit the mica occurs in the pyroxene as side veins without either calcite or apatite, probably indicating fissures from the main mica zone, which trend to the south or centre of the dyke.

At the west end of the mine the pyroxene is heavily mineralized with pyrite, and the rock is crushed and slaty and shows the presence of slickens, indicating a fault in this direction by which the pyroxene is probably cut off. At the surface the ground here is low and swampy. A patch of gray Potsdam sandstone occurs a short distance to the west with an area of 60 by 30 yards, resting on gneiss.

The mine is well equipped with a mining plant, for hoisting, drilling, &c., and is worked by a series of levels from a main hoisting shaft which has a present depth of over 160 feet. The drilling is done by

compressed air, and a fine ladder-way forms a convenient means of access to all the levels.

The occurrence of the mica crystals, often of immense size is interesting. They are found sometimes in the calcite, sometimes in the apatite; and occasionally the enclosing substance is a mixture of these two minerals. In one of the calcite masses are large crystals of pyroxene of at least six inches diameter. One crystal of mica was removed with a length of over nine feet and a breadth of from four to six feet, the quality of which was excellent. Great numbers of smaller sizes, occur an the output generally is of extra large dimensions, the crystals being in great masses, and some of the individuals weighing several tons.

Mode of
occurrence of
cystals.

Of the many smaller dykes which intersect the surface of the knolls in this area, some are soft and filled with small mica scales, others are hard and dioritic, and a passage from one to the other is sometimes exposed on the adjacent lot to the south, where several openings have been made, but here much of the mica, while of fair size, is cloudy or milky and of small value.

The mica zone at the main pit is in places from 12 to 18 feet wide, and is bounded on the south by a hard blackish diorite or a hornblende granite which sometimes assumes a reddish tint. To the east of this main pit are a number of smaller openings, some of them test pits, in a soft micaceous pyroxene in which the mica crystals are often cloudy. About 50 yards to the north are the workings of the old Smith and Lacey mine, which was also a true contact deposit and which for several years produced a considerable quantity of very large mica, but this portion of the property is now filled with water so that the old workings could not be examined. As the present mine is well developed the output should be very great and of superior quality as regards size. It is all shipped to the cutting plant of the company in Ottawa.

Among other mines in this district, most of which are not now worked, is one on Gould lake, operated by Mr. Fralick of Sydenham. The place was not visited, but the owner says the rock is the usual type of reddish and sometimes garnetiferous gneiss, overlaid in part by crystalline limestone, and cut by basic dykes of pyroxene. The mica occurs for the most part as contact deposits, between the gneiss and the dyke or between the dyke and the limestone, and sometimes in the mass of the pyroxene itself, in the first case along the foot wall in calcite. The vein is somewhat irregular in places, varying, as usual, in productiveness in different parts of the mine. No details as

Other mines.

to output or plant are to hand, but work is now being carried on, and the principal pit is down to about 50 feet.

From an examination of so many widely separated localities, it is evident that the occurrence of mica is practically the same as regards conditions throughout the whole area. In many places the only examination possible was from the surface workings, as owing to the pits being closed or filled with water, it was impossible to see the relations of the mica with the enclosing rock formations in the lower portion of the workings. Where access was possible, however, the mines were examined throughout, and the geological conditions ascertained.

The purple or lithia mica is not often found in this area and is not an article of commerce. It occurs usually where the crystalline limestone is intersected by white pegmatite dykes. An illustration of these is seen in the township of Wakefield, near Lascelles post-office and also on lot 6, range IV, of the same township. There is not sufficient mica of this variety in either place for economic mining, but the localities are interesting as mineral occurrences. Another locality for this variety is near Wilsons Corner on lot 11, range XVI, Hull.